MATERNAL SMOKING AND SOCIO-DEMOGRAPHIC CHARACTERISTICS IN CORRELATION WITH LOW BIRTH WEIGHT: A TURIN (PIEDMONT) STUDY

KAJENJE MATERE IN SOCIALNO-DEMOGRAFSKE ZNAČILNOSTI V POVEZAVI Z NIZKO PORODNO TEŽO: TORINSKA (PIEMONTSKA) ŠTUDIJA

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ABSTRACT

Key words: low birth weight, maternal smoking, newborn, pregnancy, risk factors

Introduction. 15 to 25% of women smoke during pregnancy. Scientific evidence suggests that exposure to smoking causes decreased birth weight. The aim of this study was to assess the correlation between smoking during pregnancy, maternal sociodemographic characteristics, and low birth weight.

Methods. Data were derived from 1572 questionnaires administered to each woman that gave birth at the Gynecology Teaching Hospital “S. Anna” in Turin (Italy) during the period from 2008 to 2010. Multiple logistic analysis was used to evaluate the association between socio-demographic characteristics and birth weight; the stepwise approach with a “backward elimination” procedure was followed, and the goodness of fit of the model was estimated using the Hosmer-Lemeshow test.

Results. The univariate analysis revealed that smoking cigarettes (17%), having a lower educational level (13%), and female sex of the infant (13%) seem to be risk factors, as they increase the risk of having a low birth weight child. Logistic regression analysis showed that gestational age and maternal smoking are the statistically associated variables.

Conclusions. The results confirmed that birth weight increases proportionally with the length of the gestational age and that maternal smoking and the child’s sex (female) increase the risk of having a lower birth weight. Logistic regression demonstrated that the association between maternal smoking and low birth weight shows an increased risk for the whole population (OR=2.85), for male (OR=3.45) and for female newborns (OR=2.44).

IZVLEČEK

Ključne besede: nizka porodna teža, kajenje mater, novorojenček, nosečnost, dejavniki tveganja


Rezultati. Univarjna analiza je razkrila, da kajenje cigaret (17%), nižja stopnja obrazovne (13%) in ženski spol (13%) povezujejo dejavnik tveganja, saj povečujejo tveganje, da bo otrok nizko porodno težo. Analiza z logistično regresijo je pokazala, da je tveganje za starost ženske in kajenje mater težko statistično povezani z povzročilev.

Zaključek. Rezultati potrjujejo, da se porodna teža povečuje sorazmerno z gestacijske starosti, kajenjem mater in spol otroka (ženski) in nižjo porodno težo. Logistična regresija dokazuje, da povezava med kajenjem mater in nizko porodno težo pomeni povečano tveganje za celotno populacijo (OR = 2,85), tako za novorojenčke moškega (OR = 3,45) kot tudi ženskega spola (OR = 2,44).

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1 INTRODUCTION

Despite current knowledge about the negative effects of smoking during pregnancy, it has been estimated that 15 to 25% of women worldwide smoke during pregnancy, and although a minority stop smoking for part of their pregnancy, most of them start again after delivery (1, 2).

In 1957, Simpson first recognized that maternal smoking causes lower birth weight (LBW) (3). This term identifies newborns weighing 2500 g or less at birth, independent of their gestational age. More specifically, these newborns can be classified as “very low birth weight - VLBW” (1000-1499 g) and “extremely low birth weight - ELBW” (500-999 g). This condition is related to an increase in perinatal morbidity and mortality: in fact, LBW is the second greatest cause of perinatal death after premature birth (4).

Several current scientific studies showed that smoking and secondhand smoke exposure cause a decreased birth weight (5-7).

Many of the constituents of tobacco smoke are able to pass through the fetoplacental barrier. The most harmful components that affect fetal development are nicotine and carbon monoxide (CO), which reduce placental perfusion. CO binds fetal hemoglobin (HbF), thereby forming carboxyhemoglobin (HbCO), which has a reduced affinity for oxygen and inhibits the release of oxygen into fetal tissues (8).

Nicotine causes vasoconstriction of uterine arteries with a reduction of blood flow.

As a result, the reduced area of placental exchange results in chronic hypoxia and fetal ischemia, these causing the low birth weight (9, 10).

A very recent study revealed a high level of cotinine and cadmium in the cord blood in newborns exposed to smoke (11); these tobacco metabolites have a negative correlation with birth weight (by 37–40 g) and 20% increased risk of LBW (<2500 g) (17).

The aim of this study is to assess the relationship between low birth weight of newborns in Italy in relation to maternal socio-demographic factors, including smoking habits.

2 METHODS

A cross-sectional study was carried out according to the STROBE checklist (18, 19).

A questionnaire was administrated to each woman who gave birth at the Gynecology Teaching Hospital “S. Anna” in Turin (Italy) during the period from 2008 to 2010.

Data were gathered from 2008 to 2010.

Information regarding socio-demographic characteristics were collected (shown in Table 1): nationality (Italian/not Italian), educational level (high school or graduated/ lower educational level), working status (employed/not employed), mother’s age at time of birth (in years), height of the mother (in centimeters), lifestyle habits such as maternal smoking (yes/no) and alcohol consumption (yes/no) and also some information about the newborns (sex, gestational age in weeks, presence/absence of malformation, weight of previous birth in grams).

Table 1. Description of the sample.

<table>
<thead>
<tr>
<th>Variables/Spremenljivke</th>
<th>Frequency/ Pogostost</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work/</td>
<td>yes/da</td>
<td>1098</td>
</tr>
<tr>
<td>no/</td>
<td>474</td>
<td>30.2</td>
</tr>
<tr>
<td>Educational level/</td>
<td>high (high school or graduated)/</td>
<td>695</td>
</tr>
<tr>
<td>Stopnja izobražbe</td>
<td>vsoka (srednja šola ali fakulteta) low/nizka</td>
<td></td>
</tr>
<tr>
<td></td>
<td>877</td>
<td>55.8</td>
</tr>
<tr>
<td>Nationality/</td>
<td>Italian/italijansko</td>
<td>1229</td>
</tr>
<tr>
<td></td>
<td>other/drugo</td>
<td>343</td>
</tr>
<tr>
<td>Maternal Smoking/</td>
<td>yes/da</td>
<td>136</td>
</tr>
<tr>
<td>Kajenje materen</td>
<td>no/ne</td>
<td>1436</td>
</tr>
<tr>
<td>Alcohol/</td>
<td>yes/da</td>
<td>468</td>
</tr>
<tr>
<td>Alkohol/</td>
<td>no/ne</td>
<td>1104</td>
</tr>
<tr>
<td>Children gender/</td>
<td>M/M</td>
<td>781</td>
</tr>
<tr>
<td>Spol otroka</td>
<td>F/Z</td>
<td>791</td>
</tr>
</tbody>
</table>

Mother age (median) = 31.5 years (range 17-46); SD = 5.08 / Starost matere (mediana) (= 31.5 let (razpon 17-46); SD=5.08

Celoten vzorec = 1572
Percentages and frequencies were used to describe the qualitative variables, while mean and standard deviation (SD) were used to describe the quantitative ones.

Previously, a univariate analysis was carried out using the Chi-square test for qualitative variables to investigate the association between the dependent and independent variables (low birth weight vs. socio-demographic); a t-student test and Mann-Whitney test were used to compare the quantitative ones. To check the normality of the sample, a Kolmogorov-Smirnov goodness of fit test was used; a t-student test was used for normal distributions, otherwise a Mann-Whitney test was applied.

Multiple logistic regression analysis was conducted to assess the influence on the outcome (having a low birth weight Yes/No). Only covariates, including potential confounders, with values of p<0.25 based on the univariate analysis were selected according to the procedure described by Hosmer and Lemeshow. The stepwise approach with a “backward elimination” procedure was followed. The goodness of fit of the model was estimated using the Hosmer-Lemeshow test. Results were presented as odds ratios (OR) and 95% confidence intervals (95% CI). If an individual questionnaire had missing values, it was excluded from the univariate analysis.

The univariate analysis (Table 2) revealed significant differences. Smoking cigarettes (17%) and having a lower educational level (13%) increase the risk of having a low birth weight child; female sex of the infant (13%) also seems to be a risk factor.

Three logistic regression models were performed: one concerning the whole sample and two more analyses that stratified the sample by sex (male and female newborns).

### Table 2. Univariate analysis.  
**Preglednica 2. Univariatna analiza.**

<table>
<thead>
<tr>
<th>Variables/Spremenljivke</th>
<th>No (N %)/Ne (N %)</th>
<th>Yes (N %)/Da (N %)</th>
<th>P/P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work/ (\text{Zaposlitev})</td>
<td>no/ne</td>
<td>413 (87.1)</td>
<td>61 (12.9)</td>
</tr>
<tr>
<td></td>
<td>yes/da</td>
<td>979 (89.2)</td>
<td>119 (10.8)</td>
</tr>
<tr>
<td>Educational level/ (\text{Stopnja izobražbe})</td>
<td>low/nizka</td>
<td>762 (86.9)</td>
<td>115 (13.1)</td>
</tr>
<tr>
<td></td>
<td>high (high school or graduated)/visoka (srednja Sola ali fakulteta)</td>
<td>630 (90.6)</td>
<td>65 (9.4)</td>
</tr>
<tr>
<td>Nationality/ (\text{Državljanstvo})</td>
<td>other/drugo</td>
<td>307 (89.5)</td>
<td>36 (10.5)</td>
</tr>
<tr>
<td></td>
<td>Italian/Italjansko</td>
<td>1085 (88.3)</td>
<td>144 (11.7)</td>
</tr>
<tr>
<td>Maternal Smoking/ (\text{Kajenje materе})</td>
<td>no/ne</td>
<td>1066 (89.2)</td>
<td>129 (10.8)</td>
</tr>
<tr>
<td></td>
<td>yes/da</td>
<td>113 (83.1)</td>
<td>23 (16.9)</td>
</tr>
<tr>
<td>Alcohol/ (\text{Alkohol})</td>
<td>no/ne</td>
<td>716 (88.6)</td>
<td>92 (11.4)</td>
</tr>
<tr>
<td></td>
<td>yes/da</td>
<td>413 (88.2)</td>
<td>55 (11.8)</td>
</tr>
<tr>
<td>Children gender/ (\text{Spol otroka})</td>
<td>M/M</td>
<td>705 (90.3)</td>
<td>76 (9.7)</td>
</tr>
<tr>
<td></td>
<td>F/Ž</td>
<td>687 (86.9)</td>
<td>104 (13.1)</td>
</tr>
</tbody>
</table>

**Mean (SD)/Povprečna vrednost (standardni odklon)**

- **Mother age (years)/\(\text{Starost materе (v letih)}\)** | 32.97 (5.080) | 0.437*  
- **Gestational age (weeks)/\(\text{Gestacijska starost (v tednih)}\)** | 38.9 (18.10) | <0.001

* p-value of \(\chi^2/vrednost p pri \chi^2\)  
^ t-student test/Studentov t-test
The first logistic regression analysis (Hosmer-Lemeshow test = 0.10) concerning the whole sample showed that gestational age operates as a protective factor [OR = 0.85 (CI 95% = 0.83-0.87)], since for every additional week of gestational age the risk of having a low birth weight child decreases; maternal smoking nearly triples the risk [OR = 2.85 (CI 95% = 1.41-5.76)], and female newborns appear to be more prone to having a low birth weight [OR = 2.04 (CI 95% = 1.21-3.43)].

The second analysis included only female newborns; the results of the analysis pointed out that gestational age [OR = 0.86 (CI 95% = 0.83-0.88)] seems to influence the birth weight, acting as a protective factor; in addition, maternal smoking more than doubles the risk [OR = 2.44 (CI 95% = 1.00-5.98)]. The Hosmer-Lemeshow test of the model was 0.44.

Finally, the third logistic regression analysis regarding only male newborns (Hosmer-Lemeshow test = 0.05) indicated that gestational age is a protective factor [OR =0.83 (CI 95% = 0.79-0.86)] and maternal smoking [OR = 3.45 (CI 95% = 1.11-10.75)] is a risk factor (more than triples the risk).

Table 3. Logistic regression model for low birth weight (< 2.500 grams/> 2.500 grams).

<table>
<thead>
<tr>
<th>Covariates/Kovariate</th>
<th>Total/Skupaj</th>
<th>Female/Ženske</th>
<th>Male/Moški</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Birthweight (gr)/Porodna teža (g)</td>
<td>Birthweight (gr)/Porodna teža (g)</td>
<td>Birthweight (gr)/Porodna teža (g)</td>
</tr>
<tr>
<td>Residence in Turin/Prebivališče v Torinu</td>
<td>0.77</td>
<td>0.46-1.30</td>
<td>0.69</td>
</tr>
<tr>
<td>Working status/Delovni status</td>
<td>0.85</td>
<td>0.46-1.55</td>
<td>0.75</td>
</tr>
<tr>
<td>Educational level/Stopnja izobrazbe</td>
<td>0.84</td>
<td>0.49-1.44</td>
<td>0.82</td>
</tr>
<tr>
<td>Italian nationality/Italijansko državljanstvo</td>
<td>1.24</td>
<td>0.63-2.44</td>
<td>0.88</td>
</tr>
<tr>
<td>Gestational age (weeks)/Gestacijska starost (v tednih)</td>
<td>0.85</td>
<td>0.83-0.87</td>
<td>0.86</td>
</tr>
<tr>
<td>Maternal Smoking/Kajenje materes</td>
<td>2.85</td>
<td>1.41-5.76</td>
<td>2.44</td>
</tr>
<tr>
<td>Mother age (years)/Starost materes (v letih)</td>
<td>0.98</td>
<td>0.93-1.03</td>
<td>1.02</td>
</tr>
<tr>
<td>Sex F/Spol Ž</td>
<td>2.04</td>
<td>1.21-3.43</td>
<td>...</td>
</tr>
<tr>
<td>Hosmer-Lemeshow test/Hosmer-Lemeshowov test</td>
<td>0.10</td>
<td>0.44</td>
<td>0.05</td>
</tr>
</tbody>
</table>

4 DISCUSSION

The present study highlights the relationship between low birth weight of newborns in the city of Turin related to maternal socio-demographic factors, including smoking habits during pregnancy.

The harmful effect of tobacco smoke exposure in children during and after pregnancy is one of the most important topics in public health policies (5, 14, 20-23).

A case-control study performed by Spinillo et al. demonstrated that several factors (such as male fetus, nulliparity, maternal age of 20 years or less, a history of first trimester hemorrhage and low pre-pregnancy weight) can affect the risk of fetal growth retardation associated with maternal smoking (21).

Lazzaroni et al. carried out a prospective study, investigating the effect of passive smoking during pregnancy on a set of perinatal parameters: it showed a mean reduction of 16 g in birth weight and a decrease in birth length of 0.05 cm for each hour of antenatal passive smoke exposure but no or slight effects were reported for the other perinatal parameters considered (22).

A recent case-control study presented by Fantuzzi et al. assessed the relationship between preterm/early preterm delivery and active smoking as well as environmental tobacco smoke (ETS) exposure in a sample of pregnant Italian women: a dose-response relationship was found for the number of cigarettes smoked daily (23).

For the present study, a logistic regression was performed that showed consistent outcomes.

As a matter of fact, the regression confirmed, as we expected, the evidence from scientific literature (4, 16) about the relationship between gestational age and birth weight: newborns’ weight increases proportionally with the length of the gestational age. Furthermore, infant sex plays a role in the reduction of birth weight: female newborns have an increased risk for low birth weight; maternal smoking also influences the outcome.
The variables “gestational age”, “maternal smoking”, and “child’s sex” have statistically significant values.

The association between maternal smoking and low birth weight displays an increased risk (OR=2.85) with a statistically significant Confidence Interval (CI=1.41-5.76) in the analysis regarding the whole population.

In addition, male newborns whose mothers smoked during pregnancy have a three and a half times greater risk of low birth weight (OR=3.45; CI=1.11-10.75); this was also true for female newborns (OR=2.44; CI=1.00-5.98).

These findings should be considered in light of the following limitations. It was not possible to assess the amount of underreporting of cigarette smoking or ETS exposure and cotinine levels in pregnant women, which would have facilitated an assessment of exposure and provided insight into possible misclassifications.

Moreover, no information about environmental exposure to ETS is given. This factor could affect the intensity of exposure.

In addition, the length of exposure remains unknown, since the cumulative effect could be age dependent, with older women affected differently than younger women.

Finally, even though our sample population consisted of more than 1500 women, it was limited to the city of Turin, and this sample could not fully represent the Italian situation.

5 CONCLUSION

Our study highlights the fact that the socio-demographic characteristics of women have a great influence on the fetus and, in particular, on birth weight.

Women’s behavior changes considerably during and after pregnancy, and promoting a healthy lifestyle during this particular period of life for women and their cohabitants should represent one of the main goals of Public Health strategies. In recent years, much attention has been paid to the effect of tobacco smoking during pregnancy and ETS exposure on pregnancy outcomes, and it appears that policies are needed to limit the harmful effect of the principal preventable risk factors.

COMPETING INTERESTS

None declared.

FOUNDING

None.

ETHICAL APPROVAL

Not required.

REFERENCES